Mild Cognitive Impairment: A Cluster Analysis

A significant impetus underlying current neuropsychological practice is detection and classification of neurological and neuropsychiatric disorders (Allen & Goldstein, 2013). Neuropsychologists may use various heuristic rules-of-thumb and actuarial systems to determine such diagnoses (Wedding, 1983). These clinical and statistical prediction methods have been derived from clinical observation, neuroanatomical and neurobehavioral correlates, as well as compiling psychometric data (Allen & Goldstein, 2013). The large majority of existing neuropsychological classification research has utilized mean profiles and significance-testing (e.g., Butters, Goldstein, Allen, & Shemansky, 1998; Oosterman & Scherder, 2006). A smaller subset, however, has utilized cluster analysis (i.e., a method to group subjects according to homogeneous data patterns), to classify subtypes of learning disabilities (e.g., Snow, Cohen, & Holliman, 1985), traumatic brain injury (e.g., Malec, Machulda, & Smigielski 1993), neurocognitive deficits in schizophrenia (e.g., Goldstein, Allen, & Seaton, 1998; Heinrichs & Awad, 1993), and HIV neurocognitive disorder (e.g., van Gorp et al., 1993).

Although mean profiles provide a parsimonious way to compare *a priori* diagnostic labels, the method reduces variance and minimizes individual differences. Mean profile and significance-testing studies assume diagnoses prior to neuropsychological testing and then utilize neuropsychological data to test for performance-level differences and pattern discrepancies (e.g., Butters et al., 1998). Although this method is useful in developing systems for distinguishing between disorders, it may ignore idiosyncratic patterns of neuropsychological functioning within disorders. In this sense, previous mean profiling studies have left the impression that the

majority of persons in everyday clinical practice should fit a prototypical pattern. Overreliance on heuristics and statistical predictions derived from mean profiling studies could thus lead neuropsychologists into diagnostic errors when their clients/patients' clinical presentation is conceptually fuzzy. This may be one reason why there have been inconsistent mean profiles in subcortical and cortical dementias (cf. Arango-Lasprilla, Rogers, Lengenfelder, DeLuca, Moreno, & Lopera, 2006; Butters et al., 1998; Lafosse, Corboy, Leehey, Seeberger, & Filley, 2007).

Mean profiling and significance-testing studies lack specificity by ignoring possible clusters of neurocognitive impairments across a wide-range of test performances. Homogeneous groupings of neuropsychological profiles would achieve the scientific goal of a more accurate descriptive analysis (Allen & Goldstein, 2013; Heppner, Wampold, & Kvilighan, 2008). The use of cluster analysis would help clarify homogeneous groupings of data-driven neuropsychological profiles and give a more rich description of idiosyncratic presentations of neurocognitive impairment. Neuropsychologists may then determine the typicality or atypicality of neurocognitive profiles by comparing and contrasting their findings against what is represented in various clusters. Doing so would allow neuropsychologists to make more informed and scientific decisions about the validity of their findings (Faust, 1986; Spengler, Strohmer, Dixon, & Shivy, 1995), especially if normative data is paired with neurobehavioral correlate research. Overall, this would bolster the interpretive and predictive validity of neurocognitive profiles.

Thus far, known neuropsychological research utilizing cluster analysis clarified learning disability, traumatic brain injury, neurocognitive deficits in schizophrenia, and

HIV neurocognitive disorder (e.g., Goldstein et al., 1998; Heinrichs & Awad, 1993; Malec et al., 1999; Snow et al., 1985; van Gorp et al., 1993; see Allen & Goldstein, 2013), but no known cluster analysis methods have been utilized for clarifying mild neurocognitive impairment. In response to these issues, the present study seeks to provide a more refined analysis of mild neurocognitive impairment profiles with hierarchical cluster analysis (HCA). In doing so, I sought to clarify preliminary occurrence rates of mild neurocognitive pattern subtypes. Thus, the goal of the current study is to encourage future normative research by describing possible data pattern subtypes. I chose HCA because it does not assume an underlying specified theoretical structure or multivariate normative data as does model-based clustering. I hypothesized that some clusters would generally map onto derived diagnoses commensurate with currently accepted classifications in neuropsychological practice. In addition, however, because I believed that diagnoses in everyday practice include non-prototypical data, I also predicted that there would be clusters with multiple diagnoses.